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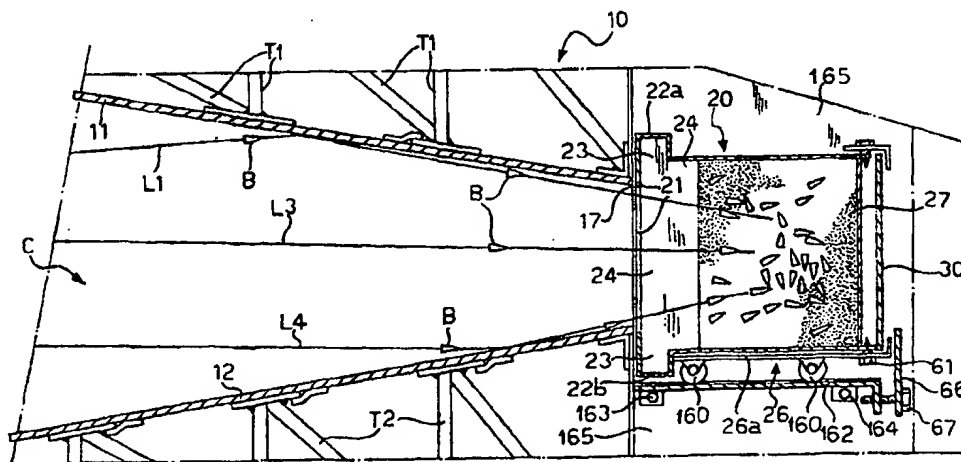


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(54) Title: PROJECTILE TRAP



(57) Abstract

The projectile trap comprises a ballistic duct (C) for deflecting the projectiles (B) having a section which decreases in the general direction of movement of the projectiles from an inlet aperture to a narrower outlet aperture (17). Adjacent the outlet aperture (17) of the ballistic duct (C) there is a structure (19) for receiving the projectiles. This receiving structure (19) comprises a supporting structure (20) containing a mass (27) of absorbent thermoplastics material intended to brake and capture the projectiles. This absorbent material has a melting point which is lower than that of the projectiles so that, after use, this mass (27) may be removed and separated thermally from the projectiles and then may be reused. The projectile structure (19) may be fixed or movable relative to the associated ballistic duct (C).

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PROJECTILE TRAP

The present invention relates to an absorbent, non-polluting projectile trap for firing ranges and the like, for receiving projectiles fired from at least one firing position located at a predetermined height and distance from the trap; the projectile trap comprising at least one ballistic duct having a section which decreases in the general direction of movement of the projectiles from an inlet section or aperture to a narrower outlet aperture, and at least one receiving structure for receiving the projectiles, the inlet of which is adjacent the outlet aperture of the ballistic duct.

The projectile trap according to the invention is characterised in that the receiving structure comprises a supporting structure which supports or contains a mass of absorbent thermoplastics material intended to brake and capture the projectiles; the mass having an inlet section which is smaller than that of the mouth of the ballistic duct and larger than, or equal to, that of the outlet aperture of the duct; the absorbent material having a melting point lower than that of the projectiles so that, after use, the mass may be removed and separated thermally from the projectiles and then re-used.

Conveniently the absorbent material comprises a mixture

of thermoplastic rubbers, synthetic resins and plasticisers with a melting point above 100°C.

In a first embodiment, the structure for supporting the projectile-receiving structure comprises a substantially tank-like container located with its inlet aperture adjacent the outlet aperture of the ballistic duct.

In another embodiment, particularly for use for shotgun cartridges, the receiving structure comprises a panel having an apertured supporting framework, such as a grid, to which a layer of the said absorbent material is attached. Conveniently an intermediate layer of expanded material is applied to this layer. Conveniently a facing layer constituted by a material which can be traversed by the shot from the cartridges but which can stop the wads liberated from the cartridges is disposed on this intermediate layer.

In general, drive means may be associated with the projectile-receiving structure for driving it to effect a controlled movement in at least one direction at an angle to the direction of arrival of the projectiles or cartridge shot.

Further characteristics and advantages of the invention will become apparent from the detailed description which follows, given purely by way of non-limitative

example, with reference to the appended drawings, in which :

Figures 1 to 5 are schematic perspective views of five different embodiments of projectile traps according to the invention,

Figures 6 and 7 are sectional views of two embodiments of projectile-receiving containers which can be used in projectile traps according to the invention.

Figure 8 is a perspective view of a system for moving the projectile-receiving structure in a projectile trap according to the invention,

Figures 9 and 10 are schematic perspective views of further embodiments of projectile traps according to the invention,

Figure 11 is a sectional view of a panel included in a projectile receiving structure of the projectile traps of figures 9 and 10,

Figures 12 and 13 are longitudinal and transverse sections respectively of a firing range including a projectile trap according to the invention,

Figure 14 is a partially-sectioned view of part of Figure 12 on an enlarged scale,

Figure 15 is a perspective view of a container for capturing projectiles included in a projectile trap of the invention,

Figures 16 and 17 are sectional views in elevation and in plan respectively of a system for testing and checking arms and ammunitions including a projectile trap of the

invention,

Figures 18 and 19 are sectional views in elevation and in plan respectively of a variant of the system of Figures 16 and 17,

Figure 20 is an elevational section of apparatus for testing and checking arms and ammunitions including a projectile trap according to the invention,

Figure 21 is a section taken on the line XXI-XXI of Figure 20,

Figure 22 is a perspective view of apparatus for the discharge of small arms including a projectile trap according to the invention,

Figure 23 is a section taken on the line XXIII-XXIII of Figure 22,

Figure 24 is a perspective view of a variant of the apparatus of Figures 22 and 23,

Figures 25 and 26 are sections taken in a horizontal plane and in a vertical plane respectively of a firing range including a plurality of firing positions and a projectile trap according to the invention,

Figure 27 and 28 are sections taken in a vertical plane and in a horizontal plane respectively of a firing range with a projectile trap according to the invention,

Figure 29 is a perspective view of a container for capturing projectiles included in a projectile trap according to Figure 27,

Figure 30 is section taken on the line XXX-XXX of Figure 29,

Figure 31 is a section taken on the line XXXI-XXXI of Figure 30, and

Figure 32 is a schematic, vertical, longitudinal section of a firing range including a projectile trap according to the invention.

Figure 1 shows schematically part of a firing range comprising a shooting gallery 1 defined by a ceiling 2, a floor 3 and two side walls 4.

A firing position located at one end of the gallery 1 is indicated P. More particularly, the firing point corresponding substantially to the position of the muzzle of the weapon held or shouldered or supported in any way at the firing position is indicated P. The point P is at a height h from the floor 3 and at a distance D from the mouth of a projectile trap generally indicated 10 located at the other end of the shooting gallery 1. In the case of shooting from a standing position, the height h is, on average, of the order of 1.5 metres.

A firing target located between the firing point or position P and the projectile trap 10 is indicated T. This target or firing shape T may, for example, be suspended from the ceiling 2 of the shooting gallery and is intended to be traversed by the projectiles fired.

In the embodiments shown by way of example in Figures 1

to 5 and 9, the projectile trap 10 includes an upper deflector plate 11, a lower deflector plate 12 and two lateral deflector plates 13, 14. These plates, conveniently made from ballistic steel with a hardness given by a Brinell number of at least 400, together form a ballistic duct C which has a section which decreases in the general direction of movement of the projectiles fired from a mouth or inlet section towards a narrower outlet section or aperture. In the embodiments of Figures 1, 2, 4 and 9, the plates 11 to 14 are inclined to the axis of the duct C. In the embodiment of Figure 3, the deflector plates 11 and 12 are inclined to the axis of the duct C while the lateral deflector plates 13 and 14 are parallel to this axis. In the embodiment of Figure 5, on the other hand, the lateral plates 13 and 14 are inclined while the upper deflector plate 11 and the lower deflector plate 12 are parallel to this axis.

In all the embodiments illustrated in figures 1 to 5 and 9, the outlet aperture of the ballistic duct C is of generally rectangular shape. This outlet aperture, in particular, may be rectangular as shown in Figures 1 to 5 in which the longer sides are vertical (Figures 1 and 5) or horizontal (Figures 2 to 4). Alternatively the outlet aperture may be square, as shown in Figure 9.

When the deflector plates of the duct C are not parallel

to the axis of this duct, they are preferably inclined to this axis such that the projectiles fired from the firing position P may hit them at an angle of incidence less than a predetermined value so that, during the impact, the projectiles may deform plasticly, effectively without breaking up so as to limit considerably, or avoid, the formation of dust and fragments. By suitable determination of this angle of incidence in relation to the height h of the firing position, the distance D between the firing position and the projectile trap, and the characteristics of the projectiles, it is possible to limit the formation of dust due to the impact of the projectiles with the plates to values of the order of 1% by weight of the projectiles, or less.

Adjacent the outlet from the ballistic duct C is a receiving structure generally indicated 19, for receiving the projectiles. In the embodiments of Figures 1 to 5, this receiving structure comprises a substantially tank-like container 20 located with its inlet aperture 21 adjacent the outlet aperture of the ballistic duct. Conveniently the area of the inlet aperture 21 of the container 20 is, in each case, less than the area of the inlet aperture of the ballistic duct C and slightly greater than, or at least equal to, the area of the outlet aperture of this duct.

As will be more fully described below, within the container 20 is a mass of absorbent thermoplastics material intended to brake and capture the fired projectiles. To advantage this material has a melting point less than that of the projectiles so that, after use, this material may be removed from the container 20 and separated thermally from the projectiles in order to be reused subsequently.

This absorbent material conveniently comprises a mixture of thermoplastic rubbers, synthetic resins and plasticisers with a melting point above 100°C.

A material particularly suitable for this purpose is the heat-fusible adhesive produced and sold by the National Starch and Chemical Company under the trade name Durotak H-203-A.

A first possible embodiment of the container 20 is illustrated in Figure 6. In this drawing, the mass of adsorbent thermoplastics material indicated 27 fills the base portion of tank-like container 20 leaving the inlet portion free so that, in use, after the absorption of projectiles, this material may expand towards the inlet aperture 21. To advantage cavities 28 may be provided in the mass of absorbent material 27, the overall volume of the cavities being determined so as to be about equal to the maximum total volume of the projectiles to be

absorbed by this mass. The cavities limit the expansion of the mass of absorbent material 27 towards the inlet aperture 21 of the container.

In order to reduce the expansion of the mass of absorbent material in an alternative way to that described above, small blocks of expanded, compressible material may be introduced thereinto during its casting in the container, particularly in the base part of the container.

The container 20 is preferably made from steel. Also it preferably has a ballistics steel safety plate 30 at its rear end, behind its base wall.

In the embodiment illustrated in Figure 7, the container 20 is coated internally with a layer 29 of expanded material which can be compressed in use by the expansion of the mass of absorbent material 27 following its absorption of the projectiles. The mass 27 may in this case be formed without internal cavities.

Preferably at least some of the lateral walls of the container 20 of Figure 7 have a plurality of vent slits or apertures indicated 31 in Figure 7 for enabling air to be vented from the expanded material 29, in use, when this latter is compressed by the expansion of the absorbent material 27.

The expanded material 29 may, for example, be a polyurethane sponge.

Further possible embodiments of the container 20 will be described below.

In general the container 20 may be mounted so as to be fixed relative to the associated ballistic duct C or so as to be movable relative thereto in use.

As shown in Figures 1 and 4, the container 20 may have an inlet aperture 21 the two dimensions of which both exceed the corresponding dimensions of the outlet aperture of the ballistic duct C and the container 20 may be mounted so as to be movable in a plane substantially parallel to the outlet aperture of the duct C by known means or by means which will be described specifically below with reference to Figure 8.

Alternatively the container 20 may have an inlet aperture 21 which is higher or wider than the outlet aperture of the ballistic duct C, as shown for example in Figures 2, 3 and 5. In this case the container 20 may be movable in use in a direction parallel to its dimension which exceeds that of the outlet aperture of the ballistic duct C, as indicated by the pairs of arrows in Figures 2, 3 and 5.

The possibility of moving the projectile-receiving structure in use and, more particularly, the container 20, enables an excessive concentration of projectiles in the central region or zone of the mass of absorbent material 27 to be avoided or allows the absorption of a greater quantity of projectiles.

The apparatus which will now be described with reference to Figure 8 may be used to move the container 20 in two perpendicular directions, that is in a plane.

In this drawing, a rectangular frame indicated 32 is movable vertical, along two vertical fixed guide rods 33. This frame 32 is connected at 34 and 35 to two chains 36a and 36b which pass over respective sprockets 37 carried by a shaft 38 rotatable in two stationary supports 39.

The chain 36a passes beneath a sprocket 40 and is then connected to the lower cross-member of the frame 32 at 41.

The lower end of the chain 36b is connected to a rod 42 slidable in the body 43 of an actuator generally indicated 44. This actuator, which is of known type, extends or retracts the movable rod 42 so as to cause the controlled movement of the frame 32 along the guides 33.

A structure indicated 45 is movable horizontally relative

to the frame 32 along an upper guide 46 and a lower cross member 47 of the frame. The movable support structure 45 illustrated comprises essentially two parallel uprights 48 between which a receptacle 49 is connected for receiving and retaining the container 20 with the mass 27 of material for absorbing the projectiles. The movement of the movable structure 45 relative to the frame 32 is controlled by means of an actuator 50 similar to the actuator 44 and having, for example, its body fixed to the upper cross-member of the frame 32 and its extensible shaft 51 connected to the structure 45.

The actuators 44 and 50 may, for example, be linear actuators produced and sold by SKF and including an electric motor which can drive the movable shaft through a geared reduction unit and worm-screw transmission.

It is possible to cause the container 20 carried by the support structure 45 to move in a plane by coordinated actuation of these actuators.

The structure just described with reference to Figure 8 may be simplified in a manner obvious to an expert in the art when it is wished to move the container 20 solely in one direction, as indicated schematically for example in Figures 2, 3 and 5.

The projectile traps described above with reference to

Figures 1 to 8 are suitable for use for the firing of single-projectile ammunition fired from short- or long-barrelled small arms.

With reference to Figures 9 and 10, two embodiments of projectile traps according to the invention will now be described for use in the firing of shotgun cartridges, that is the ammunition typical for sporting guns.

In the projectile trap of the Figure 9, the ballistic duct C is essentially of the type already described above, that is with flat deflector plates.

In the embodiment of Figure 10, the ballistic duct C is formed by a single ballistics-steel element, effectively in the form of a conic frustum.

In both embodiments, the receiving structure 19 for the shot fired comprises a panel 60. In the embodiment of Figure 9, this panel is rectangular in shape while in the embodiment of Figure 10 this panel is essentially circular.

One portion of the cross-section of these panels 60 is shown in Figure 11. As seen in this drawing, the panel 60 comprises a supporting framework 61 constituted, for example, by a metal grid, to which is anchored a layer 62 of absorbent thermoplastics material which, again in this

case, may be constituted by the heat-fusible adhesive Durotak H-203-A made by the National Starch and Chemical Company. Conveniently the grid 61 may be incorporated adjacent the rear face of the layer of absorbent material 62.

An intermediate layer 63 of expanded material, for example a polyurethane sponge, is applied over the layer 62 and, over this intermediate layer is a facing layer 65 constituted by a material which can be traversed by the pellets from the cartridges but which can stop the wads freed from the cartridges. The facing layer 65 may, for example, be of PVC.

Behind the panels 60 of Figures 9 and 10 there may be a safety plate of ballistic steel not shown.

In the projectile traps of Figures 9 and 10, the absorbent panel 60 may be fixed relative to the associated ballistic duct C or movable relative thereto, again in a single direction or in two mutually-perpendicular directions, as shown by the arrows in Figure 9. For this purpose, systems similar to those usable with the tank-like containers of the projectile traps of Figures 1 to 5 may be used.

In the case of the projectile trap of Figure 10, the absorbent panel 60 may have associated drive devices for

rotating it about an axis which is eccentric with regard to the axis of the ballistic duct C so that it presents different portions of its surface to the outlet aperture of this duct over a period of time. Alternatively, the panel 60 may have associated devices for driving combined rotational and translational movements so as to expose different portions of its surface to the outlet aperture of the ballistic duct C.

Figures 12 and 13 show schematically part of a firing range comprising a shooting gallery 1 with a ceiling 2 and two side walls 4. In the embodiment illustrated, the projectile trap 10 comprises an upper deflector plate 11 and a lower deflector plate 12. These plates are inclined so as to converge towards the end of the shooting gallery opposite the firing positions P.

As seen in Figure 13, in the embodiment illustrated, the projectile trap of the shooting gallery 1 includes three sections, indicated A1, A2 and A3, for receiving and collecting projectiles fired from each of three firing positions P. The sections of the projectile traps 10 of Figure 13 are substantially the same as each other.

As seen in Figures 12 and 14, the upper deflector plate 11 is suspended from a lattice truss structure T1 fixed at its sides to vertical side plates M (Figures 12 and 13) which extend substantially the entire length and

height of the projectile trap 10. The lower deflector plate 12 is supported by a similar lattice truss structure T2 also fixed to the side plates M and resting on the floor 3.

A respective projectile-receiving container 20 is connected to the outlet aperture 17 of each section of the projectile trap 10. As best seen in Figures 14 and 15, each container 20 is essentially tank-like and arranged with its inlet aperture 21 in a substantially vertical plane adjacent the outlet aperture 17 of the associated ballistic duct.

The container 20 contains a mass 27 of absorbent thermoplastic material such as that mentioned previously. This mass may have internal cavities as indicated previously with reference to Figure 6 or may be surrounded by a layer of expanded material as illustrated in Figure 7 or may be solid, or may encapsulate blocks of compressible material as indicated above.

As clearly seen in Figures 12 and 14 the inlet aperture 21 of a container 20 can be traversed by projectiles B coming from the associated firing position P both in direct trajectories, such as those indicated L3, and in trajectories which involve at least one impact with a deflector plate 11 or 12, as in the case of the

trajectories L1, L2 and L4.

As seen in Figure 14, the mass of absorbent material 27 occupies the base portion of the container 20, leaving the inlet portion free so that, in use, this material may expand towards the inlet aperture 21 of the container itself as a result of the absorption of the projectiles B.

In the embodiment illustrated, the two larger lateral walls of the container 20 are shaped so as to form two channels, indicated 22a and 22b in Figure 14, adjacent the horizontal edges of the inlet aperture 21. Within the container 20, beyond the inlet aperture 21 there is thus a first inlet zone 23 having a height greater than that of this aperture. Downstream of this first inlet zone there is a second zone indicated 24 in Figure 14, of a lower height, equal to that of the remaining part of the container which houses the absorbent material 27.

In use, the projectiles B fired from a firing position reach the receiving container 20 (directly or after at least one rebound from one of the deflector walls 11 and 12) and penetrate the mass of absorbent material 27. The projectiles form holes in this mass but these immediately heal by virtue of the thermoplastic nature of the absorbent material.

In use, the overall volume of the mass 27 and of the projectiles absorbed therein increases progressively. This mass expands progressively towards the inlet aperture 21 of the container but the ducts 22a and 22b (particularly the latter) contain this increased volume so that the mass does not debouch into the ballistic duct C.

After a given number of projectiles have been fired from a firing position, the associated container 20 may be removed. The absorbent material contained therein is heated and, in particular, brought to a temperature equal to or above its melting point so as to enable the projectiles to be separated from the thermoplastic absorbent material which may then be cast again in the same or in a similar container to be reused after solidification. The absorbent material may thus, with advantage, be recycled and reused innumerable times.

If the container 20 is essentially of the type illustrated with reference to Figure 7, the absorbent mass 27 and the projectiles contained therein are first separated from the coating of expanded material. Again in this case the absorbent material may be separated thermally from the projectiles and used again.

Again in the case of the panel 60 of Figure 11, the absorbent material, once saturated, may be separated

mechanically from the intermediate and facing layers and from the supporting grid and may be separated from the projectiles by heating for subsequent reuse.

In the embodiment illustrated in Figure 14, the projectile-receiving container 20 is suitably provided at its rear end with a safety plate of ballistic steel, indicated 30. This container rests on a carriage 26 with wheels 160 beneath it. Instead of wheels, the carriage 26 may simply have skids. The container 20 is fixed to the carriage 26 by screws 61.

The carriage 26 is slidable on two horizontal guides 162 (of which only one is visible in Figure 14) fixed at 163 to two vertical side plates 165 (of which again only one is visible in Figure 14).

The container 20 and its carriage 26 are held in position by a rear stop cross member 66 fixed to appendages of the guides 162 by screws 67 (Figure 14).

With reference to Figure 13, the vertical plates 165, which are rigidly fixed to the deflector plates 11 and 12, separate the projectile-receiving containers 20 associated with the various sections A1, A2, A3 of the projectile trap from each other. The edges of these plates 165 which are nearer the firing positions are covered by a V- sections 68, the vertices of which face

the firing position.

The projectile trap of Figures 12 to 15 may readily be made in modular form. If Figure 13 is considered, the sections A1, A2 and A3 of the projectile trap may be constituted by individual modules which are structurally identical to each other and joined together along the broken lines indicated X. Thus it is possible to form projectile traps extremely simply with any number of sections, without any break between them, for firing ranges with any number of associated firing positions.

Figures 16 and 17 illustrate a system for testing and checking arms and munitions including a projectile trap 10 according to the invention illustrated in very schematic form. In these drawings, a bench indicated 70 can move along guides or rails 71 in a direction perpendicular to the firing direction. A weapon 72 is mounted in a locked position on this bench with its muzzle facing the projectile trap 10. This latter has a small ballistic duct C in view of the fact that the apparatus illustrated is intended to test firing with the weapon 72 locked on the bench 70. The ballistic duct C of the projectile trap is, in particular, of the type illustrated schematically in Figure 3, with substantially parallel side walls 13 and 14. The container 20 with the absorbent material 27 is preferably mounted in a fixed position relative to the ballistic duct C and has

a width corresponding to that of this duct.

The system illustrated in Figures 16 and 17 enables firing tests and weapons trials to be carried out even with volley firing. The system is also suitable for trials with munitions of various types, for example with ordinary armoured, fragmenting, tracer, armour-piercing, incendiary, semi-jacketed and non-jacketed projectiles. After a certain number of tests, when the absorbent material 27 has become saturated, the container 20 may be removed from the ballistic duct to enable the projectiles and the absorbent material to be separated and recovered.

Figures 18 and 19 illustrate a variant of the system just described with reference to Figures 16 and 17. In this variant, the bench 70 is fixed in front of a projectile trap 10 in which the container 20 for the mass of absorbent material 27 is movable (at least in the vertical sense) relative to the ballistic duct C to enable a very large number of projectiles to be absorbed.

In addition to the arms and/or munitions testing and checking systems illustrated in Figures 16 to 19, many others can be formed with a projectile trap according to the invention with various possibilities for the movement of the projectile-receiving container described above. This container may also have any one of the structures described above.

Figures 20 and 21 show projectile trap apparatus according to the invention which can be used for the testing and checking of arms and munitions. This apparatus has a support structure, generally indicated 75, which supports an elongate tunnel housing 76 disposed with its axis substantially horizontal. The housing has an end wall 77 with an aperture 78 for the introduction of a user's hand gripping a weapon indicated 79 in Figure 20. Above the aperture 78, the wall 77 has a window 80 closed by a transparent element 81.

A ballistic duct C is formed in the housing 76 with its deflector plates inclined to the axis. In the embodiment illustrated, the ballistic duct C has four duct portions 82 to 85 which are substantially hopper shaped and arranged in succession.

The other end wall 86 of the housing 76 has an aperture in a position corresponding to the outlet section of the ballistic duct C. A container 20 of one of the types described above, containing a mass of absorbent material 27, is mounted around this aperture outside the housing 76 and is removable therefrom.

As seen in Figure 20, a lamp 87 is mounted within the duct C, in the housing 76, close to the window 81 for illuminating the region of the ballistic duct C in which the weapon 79 is introduced in use.

In the embodiment illustrated in Figure 20, the lower wall of the housing 76 has an aperture 78 close to the end wall 86. This aperture puts the region within the housing 76 in communication with the inlet of an air exhaustion and purification apparatus generally indicated 90 located beneath the housing 76. This apparatus may include, in known manner, filters 91 and downstream thereof a fan 92. The exhaustion and purification apparatus 90 cleanses the air exhausted from the ballistic duct of any lead dust or particles or the like produced during the firing and thus enables clean air to be released into the surrounding environment as indicated by the arrow F in Figure 20.

Conveniently the walls of the housing 76 have one or more layers of sound-proofing material on their internal surfaces.

Sensors 94, 95 may also be provided within the housing 76, adjacent the ballistic duct C, for outputting electrical signals from which the velocities of the projectiles fired may be deduced. The sensors may be of any known type. In the embodiment illustrated, the sensors are arranged in the spaces between the sections 82, 83 and 84, 85 respectively of the ballistic duct C.

As an alternative to the arrangement described above, the container 20 may have an associated drive system for

moving it in at least one direction relative to the ballistic duct.

Figures 22 to 24 show projectile trap apparatus according to the invention usable particularly for the firing of small arms.

In the embodiment of Figures 22 and 23, the projectile trap apparatus includes a rigid supporting cabinet 100 of substantially rectangular-box shape mounted on casters.

A mouthpiece 103 is fitted into an aperture in the centre of the top wall 102 of this cabinet for the introduction of the barrel of a weapon to be fired.

The region within the cabinet 100 is divided into an upper compartment 104 and a lower compartment 105 by a transverse partition 106 having a central aperture 107.

Within the upper compartment 104, within a multi-layer covering of sound-proofing material 108, is a central, vertical passage 119 in which there is fitted a ballistic duct C with several sections similar to the ballistic duct of the apparatus described previously with reference to Figures 20 and 21. The outlet section of the ballistic duct C is adjacent the central aperture 107 in the internal transverse partition 106.

In the lower compartment 105, adjacent the outlet aperture from the ballistic duct C, is releasably mounted a container 20 of one of the types described above, containing a mass 27 of thermoplastics material for absorbing the projectiles.

The side walls of the cabinet 100 around the upper compartment 104 preferably have a plurality of apertures or slits 109.

The cabinet 100 is formed so as to allow the container 20 to be removed when the mass of absorbent material 27 has become saturated with projectiles.

In the embodiment shown in Figure 24, the cabinet 100 does not have casters but is mounted so as to be rotatable about a horizontal axis in a stationary support structure which, in the embodiment illustrated, comprises a pair of trestles 110. The cabinet 100 may conveniently be locked in different angular positions by releasable locking devices of known type.

Figures 25 and 26 illustrate a projectile trap according to the invention including a plurality of sections each of which includes a respective ballistic duct C defined between a pair of vertical, converging deflector plates 13 and 14. The side plate 14 of one ballistic duct is connected to the plate 13 of the adjacent ballistic duct

so as to form a sort of vertical, acute dihedron with the corner facing the firing positions P.

The outlet aperture of each ballistic duct C is associated with a respective container 20 of one of the types described above including a mass of absorbent material 27 for capturing projectiles. The containers 20 may be arranged in respective fixed positions or may be coupled to a system, not illustrated, for causing their coordinated translational movement in a horizontal direction, perpendicular to the axes of the associated ballistic ducts. In the case of movable containers 20, these may obviously have inlet apertures and transverse sections wider than those of the outlet apertures of the associated ballistic ducts.

The projectile trap 10 of Figures 25 and 26 is in modular form for use in fixed or movable firing ranges and the like.

Figures 27 and 28 show schematically part of a firing range including a multiple projectile-trap structure 10 according to the invention. In Figures 27 and 28 parts the same as, or corresponding to, parts already described have been attributed the same reference numerals. In these drawings, a shooting gallery 1 is shown in particular which is defined by a ceiling 2, a floor 3 and two side walls 4. A firing position arranged at one end

of the gallery 1 is indicated P and firing targets each arranged between a firing point or position P and a respective portion of the projectile trap structure 10 are indicated T.

The projectile trap structure includes at least one upper deflector plate 11 and a lower deflector plate 12 inclined so as to converge towards the end of the shooting gallery 1 opposite the firing positions P. The convergent ends of the plates 11 and 12 do not however touch as is seen in Figures 27 and even better in Figure 30.

With reference to Figure 28, the projectile trap structure 10 illustrated includes three sections or portions indicated A1, A2 and A3 for receiving and collecting projectiles fired from each of the three associated firing positions. The three sections of the projectile trap structure 10 are substantially identical to each other and hence only one will be described below.

In each section of the projectile trap structure, two side deflector plates 13 and 14 extend between the upper and lower deflector plates 11 and 12 respectively and lie in vertical planes which converge in the same direction of convergence as the plates 11 and 12. As seen in Figure 28, the front edges of the side plates 14 of the sections A1 and A2 are joined to the front edges of the

deflector plates 13 of the sections A2 and A3 respectively forming vertical, acute-angled dihedrons the corners of which are pointed like knife-edges and indicated 15.

Together the plates 11 and 12 and the plates 13 and 14 form three ballistic ducts having transverse sections which decrease in the general direction of firing of the projectiles. These ducts C are essentially in the form of horizontal hoppers with narrow outlet apertures 17. More particularly, these outlet apertures are in the shape of thin, vertical rectangles.

The complex comprising the deflector plates 11 to 14 is supported by conventional support means, for example by means of pillars indicated 18 in Figures 27 and 28.

The deflector plates 11 to 14 are preferably inclined to the longitudinal axis of the section of the projectile-trap structure to which they belong in such a manner that the projectiles fired from the associated firing position P can hit the plates at an angle of incidence α which is less than a value predetermined in accordance with the characteristics of the projectiles used. Thus, in impacting, the projectiles can at most deform plastically, without breaking up, thus avoiding the formation of dust and fragments. This angle of incidence is preferably kept at less than 7° .

The outlet aperture 17 of each section of the projectile-trap structure 10 is connected to a respective container 20 for capturing the projectiles.

In the embodiment illustrated in Figures 29 to 31, a container 20 includes a base element 122 substantially in the form of a tray without a side wall, instead of which there is an aperture 121 surrounded by a flange 123 for attachment to a corresponding flange surrounding the outlet aperture 17 of a ballistic duct C.

The base element 122 of the container 20 is surmounted by a removable lid 124. In the embodiment illustrated, this lid 124 includes a first web 124a coplanar with the upper deflector plate 11 (see in particular Figure 30). The web 124a of this lid is connected to an intermediate, substantially vertical web 124b at a corner indicated 25 in Figure 30. The upper edge of the web 124b is connected at an angle to a further web 124c which is substantially horizontal.

The container 120 defines a space 126 (Figure 30) between the base of the base element 122 and the webs 124b and 124c. This space houses a generally rectangular block or cake 27 of absorbent thermoplastics material of the type mentioned above.

As seen in particular in Figure 30, the height of the

block of absorbent material 27 is such that its upper fac is at a level higher than the corner 125 of the lid 124.

The inclination of the deflector plates 11 and 12 and the conformation of the lid 124 of the container 20 are such that the corner 125 is not "visible" from the associated firing point P. In other words the arrangement is such that the vertical face of the block of absorbent material 27 facing the firing position can be reached by projectiles only after at least one impact with one of the deflector walls 11 to 14. Put in another way, a projectile from a firing point P is not able to penetrate the block of absorbent material 27 directly without hitting at least one of the deflector plates 11 to 14.

This condition means that the kinetic energy of the projectiles is reduced by their impacts with the deflector plates and this enables a block of absorbent material 27 of smaller depth to be used. This depth is generally determined on the basis of the characteristics of the projectiles and the firing distance such that the projectiles captured in the block of absorbent material are braked totally before they reach the rear wall of the container 20.

Conveniently, as shown in Figure 30, the block of absorbent material 27 does not occupy the entire space

126 in the container 20. As the number of projectiles captured increases, the block 27 increases in overall volume, essentially expanding upwardly towards the web 124c of the lid 124.

In the projectile-trap structure described above with reference to Figures 27 and 28, containers of a different shape may be used instead of the containers 20 specifically described and illustrated, such containers being substantially of the type described previously but with any obvious modifications necessary to respect the condition that the projectiles reach the absorbent material only after impact with at least one deflector plate of a ballistic duct.

Although not illustrated in the drawings, a projectile trap which corresponds to a single section of the projectile-trap structure shown in Figures 27 and 28 falls within the scope of the invention. Such a single projectile trap may be used not only for the firing of single-projectile munitions but also for checking the characteristics of shotgun cartridges such as those typically used for hunting weapons.

Finally, although the containers 20 of the projectile-trap structure of Figures 27 and 28 have been illustrated as fixed removably to the associated ballistic ducts, it will be clear to experts in the art that means may again

be provided in this case for moving the containers relative to the associated ballistic ducts.

Figure 32 illustrates a projectile-trap structure according to the invention which can be used, for example, for short-range firing ranges or at least for reducing the longitudinal extent of the projectile-trap structure.

The projectile-trap structure 10 shown in this drawing comprises a plurality of ballistic ducts indicated C1 to Cn located in a superposed array, with the respective inlet apertures arranged along the arc of a vertical circle the centre of which is substantially on the firing point P. Each ballistic duct C1 to Cn may have a structure the same as or similar to that of each projectile trap or projectile-trap section described above and includes a pair of deflector plates, upper and lower 11 and 12 respectively. The outlet apertures 17 of these ducts are associated with respective projectile capture and receiving devices 20 of the types described above containing respective masses of absorbent thermoplastics material 27.

The geometry of each ballistic duct C1 to Cn of Figure 32 is determined on the basis of the height of the firing point P and the distance between this point and the projectile-trap structure so that the mass of

thermoplastics material 27 of each projectile-receiving device 20 may be reached by projectiles from the firing point travelling along direct trajectories or along trajectories which involve at least one impact with one of the deflector plates of a ballistic duct. In this case the geometry is preferably determined such that any impact of the projectiles leaving the firing point P with the deflector plates 11 and 12 occurs at an angle of incidence less than a predetermined value such as to avoid fragmentation of the projectiles.

As an alternative to the embodiment illustrated in Figure 32, it is possible to form similar projectile trap structures with ballistic ducts superposed in an array and with projectile-receiving devices essentially of the type described above with reference to Figures 29 and 30, that is, such that the absorbent material 27 contained therein is not "visible" from the firing point and may thus be reached by the projectiles only after at least one impact with one of the deflector plates. Again in this case, the geometry is preferably such that the impact of a projectile leaving the firing point P with any one of the deflector plates occurs at an angle of incidence less than a predetermined value such as to avoid fragmentation of the projectile.

Naturally, the principle of the invention remaining the same, the forms of embodiment and particulars of

realisation may be varied widely with respect to those described and illustrated purely by way of non-limitative example, without thereby departing from the scope of the present invention.

CLAIMS

1. An absorbent, non-polluting, projectile trap for firing ranges and the like, for receiving projectiles (B) fired from at least one firing position (P) situated at a predetermined height (h) and distance (D) from the projectile trap (10); the projectile trap comprising:

a ballistic duct (C) for deflecting the projectiles, having a section which decreases in the general direction of movement of the projectiles (B) from an inlet aperture or section towards a narrower outlet aperture (17), and

at least one structure (19) for receiving the projectiles (B), the inlet (21) of which is adjacent the outlet aperture (17) of the ballistic duct (C); characterised in that the receiving structure (19) includes a supporting structure (20;61) which supports or contains a mass (27) of an absorbent thermoplastics material intended to brake and capture the projectiles (B); the mass (27) having an inlet section which is smaller than that of the inlet aperture of the ballistic duct (C) and greater than, or equal to, that of the outlet aperture (17) of the duct (C); the absorbent material (27) having a melting point lower than that of the projectiles (B) so that, after use, the mass (27) may be removed and separated thermally from the projectiles (B) and then re-used.

2. A projectile trap according to Claim 1, in which the

mass (27) of absorbent material comprises a mixture of thermoplastic rubbers, synthetic resins and plasticisers, with a melting point above 100°C.

3. A projectile trap according to Claim 1 or Claim 2, characterised in that the ballistic duct (C) is formed by a plurality of inclined deflector plates (11 to 14).

4. A projectile trap according to any one of the preceding Claims, characterised in that the supporting structure comprises a container (20) arranged with its inlet aperture (21) adjacent the outlet aperture (17) of the ballistic duct (C).

5. A projectile trap according to Claim 4, characterised in that the mass (27) of thermoplastics material fills the base part of the container (20) leaving the inlet portion (23,24) free so that, in use, following absorption of the projectiles (B), the material (27) may expand towards the inlet aperture (21) of the container (20).

6. A projectile trap according to Claim 4 or Claim 5, characterised in that cavities (28) are provided in the mass (27) of absorbent material, the overall volume of the cavities being predetermined in dependence on the total maximum volume of the projectiles (B) to be absorbed.

7. A projectile trap according to Claim 4 or Claim 5, characterised in that at least the two side walls of the container (20) are coated internally with an expanded material (29) which can be compressed in use by the expansion of the absorbent mass (27) as a result of its encapsulation of the projectiles (B).

8. A projectile trap according to Claim 7, characterised in that the side walls of the container (20) adjacent the expanded material (29) have a plurality of vent slits or apertures (31) for allowing air in the expanded material (29) to escape in use when the expanded material is compressed by the increase in volume of the mass of absorbent material (27).

9. A projectile trap according to Claim 7 or Claim 8, characterised in that the expanded material is polyurethane-based.

10. A projectile trap according to any one of Claims 4 to 9, characterised in that the container (20) is substantially parallelepipedal in shape with a rectangular inlet aperture (21) beyond which are a first inlet portion (23) which has a greater height than the inlet aperture (21) and a second inlet portion (24) having a height which is less than that of the first inlet portion (23) so that a collecting channel (22b) is formed in the said first inlet portion (23) along the

lower edge of the inlet aperture (21) .

11. A projectile trap according to any one of Claims 1 to 3, characterised in that the receiving structure (19) comprises a panel (60) including an apertured supporting framework (61) to which is fixed a layer (62) of the absorbent thermoplastics material.

12. A projectile trap according to Claim 11, characterised in that the supporting framework is constituted by a metal grid (61).

13. A projectile trap according to Claim 11 or Claim 12, particularly for use for shotgun cartridges, characterised in that an intermediate layer (63) of expanded material is applied over the said layer of absorbent material (62), the intermediate layer being compressible in use by the expansion of the layer of absorbent material (62) as a result of its encapsulation of shot released from the fired cartridges.

14. A projectile trap according to Claim 13, characterised in that a facing layer (65) constituted by a material which can be traversed by shot from the cartridges but which can stop wads freed from the cartridges is provided on the layer (63) of expanded material.

15. A projectile trap according to any one of Claims 1 to 14, characterised in that the mass (27;62,64) of absorbent material in the receiving structure (19) has a projectile-inlet section which is larger than the outlet aperture (17) of the associated ballistic duct (C) and in that drive means (32 to 51) are associated with the receiving structure (19) for driving its controlled movement in at least one direction at an angle to the direction of arrival of the projectiles or cartridge shot.

16. A projectile trap according to Claim 15, characterised in that the drive means (32 to 51) are arranged to move the receiving structure (19) in a plane substantially perpendicular to the direction of arrival of the projectiles or cartridge shot.

17. A projectile trap according to Claim 4 or Claim 10 and Claim 16, characterised in that the drive means (32 to 51) are arranged to displace the container (20) in two mutually perpendicular directions.

18. A projectile trap according to Claims 11 and 15, characterised in that the drive means are arranged to rotate the panel (60) about an axis substantially parallel to the axis of the associated ballistic duct (C).

19. A projectile trap according to Claim 18, characterised in that the drive means are arranged to rotate the panel (60) about an axis and to move this axis in a direction parallel to the plane of rotation of the panel (60).

20. A projectile trap according to any one of Claims 4 to 9, characterised in that the container (20) is connected to the outlet aperture (17) of the associated ballistic duct (C) in a releasable manner.

21. A projectile trap according to Claim 20, characterised in that the container (20) is slidable on a support and guide structure (62) fixed to the ballistic duct (C); releasable locking means (66,67) being provided for clamping the container (20) in its operative condition in which its inlet aperture (21) faces and is adjacent the outlet aperture (17) of the ballistic duct (C).

22. A projectile trap according to any one of Claims 4 to 10 and 20, 21, characterised in that the container (20) is provided with a ballistic-steel safety plate (30) at its rear end behind its base wall.

23. A projectile trap according to any one of Claims 4 to 10 and 20 to 22, particularly for testing and checking small arms and munitions, characterised in that it

includes a support structure (75) which supports an elongate tunnel housing (76) with its axis horizontal in operation; the tunnel housing (76) being provided with the ballistic duct (C) within it; the container (20) containing the mass (27) of absorbent material being located adjacent the outlet aperture of the duct (C) at one end of the housing (76); the other end of the housing (76) being closed by a wall (77) having an aperture for allowing the introduction of the user's hand gripping a weapon (79) and, in a higher position, a transparent window (80,81) for allowing the user to see the weapon (79) introduced.

24. A projectile trap according to Claim 23, characterised in that, within the housing (76) adjacent the window (80,81), there is at least one light source (87) for illuminating the region in which the weapon (79) is introduced in use.

25. A projectile trap according to Claim 23 or Claim 24, characterised in that sensor means (94,95) are provided in the casing (76) for providing electrical signals indicative of the speed of the projectiles fired.

26. A projectile trap according to any one of Claims 23 to 25, characterised in that air exhaustion and purification means (90) are supported adjacent the housing (76) for exhausting air from the housing (76)

close to the outlet from the ballistic duct (C) and for purifying the air withdrawn before reintroducing it into the surrounding environment.

27. A projectile trap according to any one of Claims 4 to 10 and 20 to 22, particularly for the discharge of small arms, characterised in that it comprises an elongate support casing (100) having an end wall (102) with a mouth or aperture (103) for the introduction of the barrel of a weapon (79) to be discharged, the casing (100) being divided into first and second compartments (104,105) by a transverse partition (106) having an aperture (107); the first compartment (104) being adjacent the end wall (102) of the casing (100) and being coated with sound-proofing means (108); the central region of the first compartment (105) being formed with a duct (C) whose output section is adjacent the aperture (107) in the transverse wall (106); the container (20) containing the mass (27) of absorbent material for receiving the projectiles (B) being arranged in the second compartment (105) adjacent the aperture (107) in the transverse wall (106).

28. A projectile trap according to Claim 27, characterised in that the axis of the ballistic duct (C) is arranged vertically and the end wall (102) of the casing (100) having the aperture (103) for the introduction of a weapon (79) is the top wall of the

casing (100).

29. A projectile trap according to Claim 27, characterised in that the support casing (100) is mounted in a stationary support structure (110) so as to be rotatable about an axis substantially perpendicular to the axis of the ballistic duct (C).

30. A projectile trap according to Claim 29, characterised in that the support structure (110) has releasable locking means for locking the casing (100) in a desired position relative to the support structure (110).

31. A projectile trap according to any one of Claims 4 to 10 and 20 to 22, characterised in that the container (20) is shaped so that its inlet (21) can be reached by a projectile (B) fired from a firing position (P) only after at least one impact with a wall (11 to 14) of the ballistic duct (C).

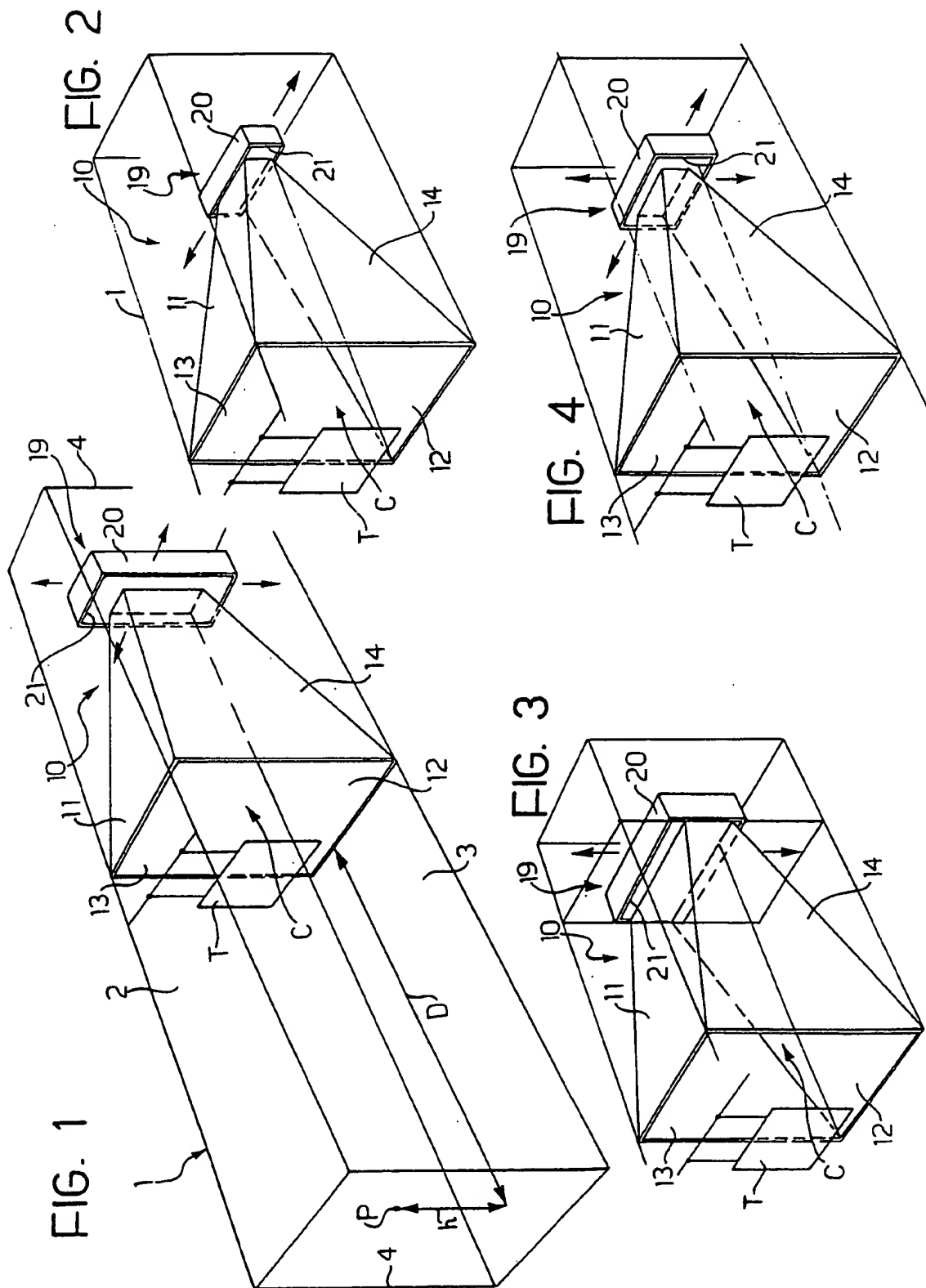
32. A projectile trap according to Claim 31, characterised in that the container (26) has a removable cover (124) for allowing the removal and replacement of the mass (27) of absorbent material contained therein.

33. A projectile trap according to any one of Claims 4 to 10, 20 to 22, 30 to 31, comprising a plurality of

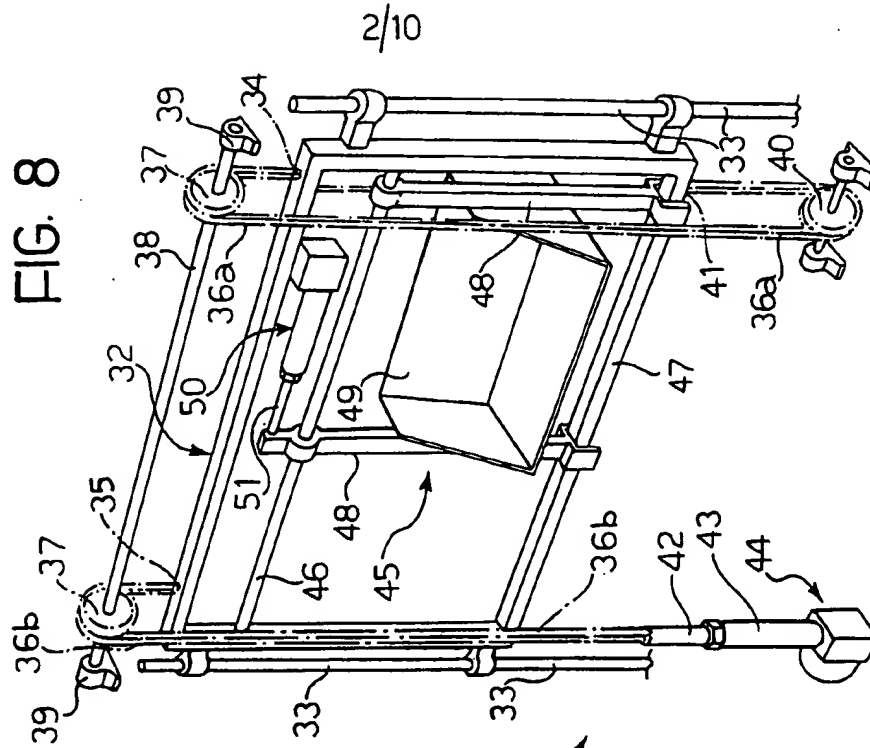
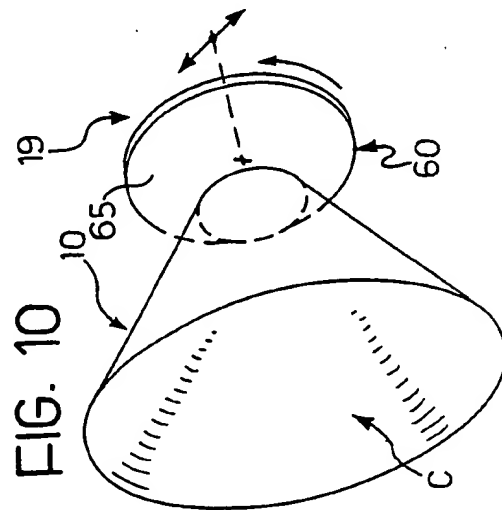
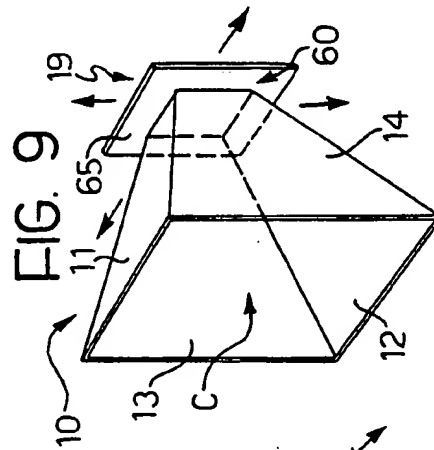
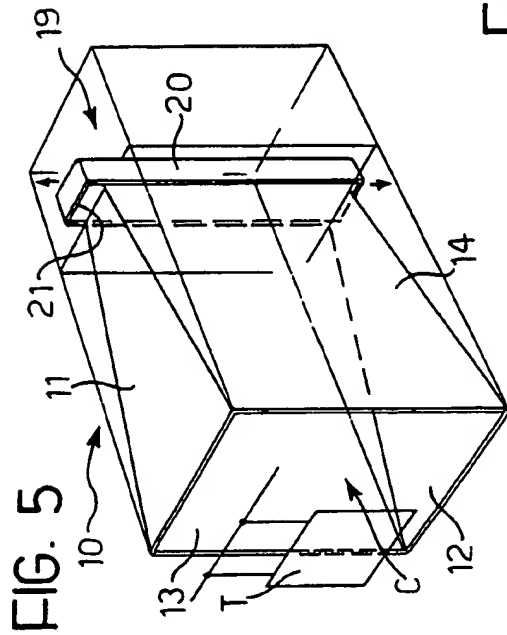
ballistic ducts (C1-Cn) in superposed positions with their respective inlet apertures adjacent; the outlet aperture (17) of each ballistic duct (C1-Cn) being associated with a respective container (26) for capturing projectiles, each containing a respective mass (27) of absorbent material.

34. A projectile trap according to Claim 33, in which the ballistic ducts (C1-Cn) are the same as each other and superposed in an array along an arc of a vertical circle the centre of which is situated substantially on the firing point (P) of the associated firing position.

35. A projectile trap according to Claim 4 or Claim 5, characterised in that elements of compressible material are encapsulated in the mass (27) of absorbent material.

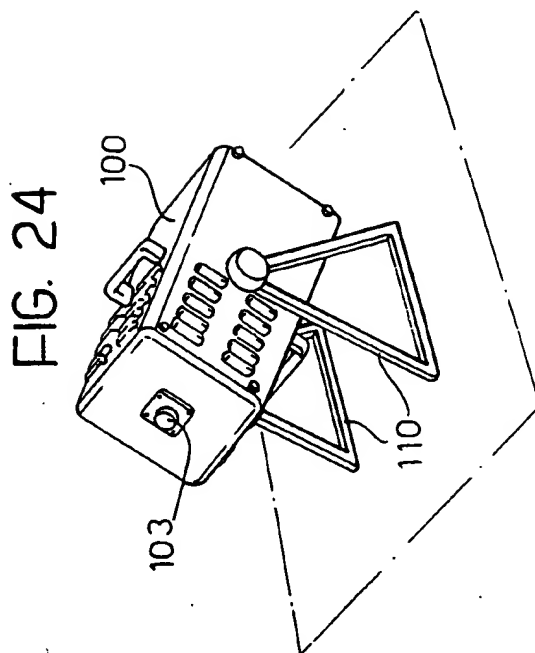
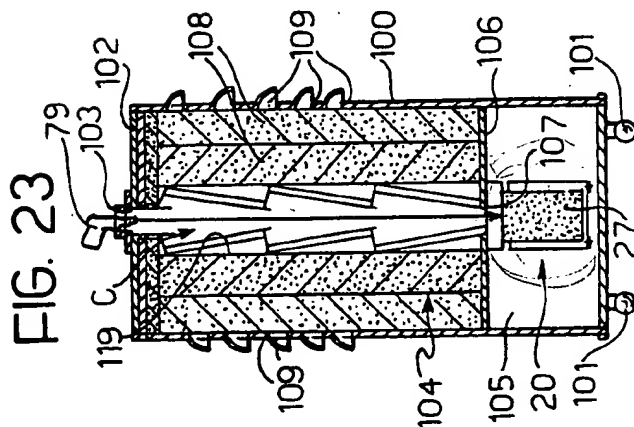
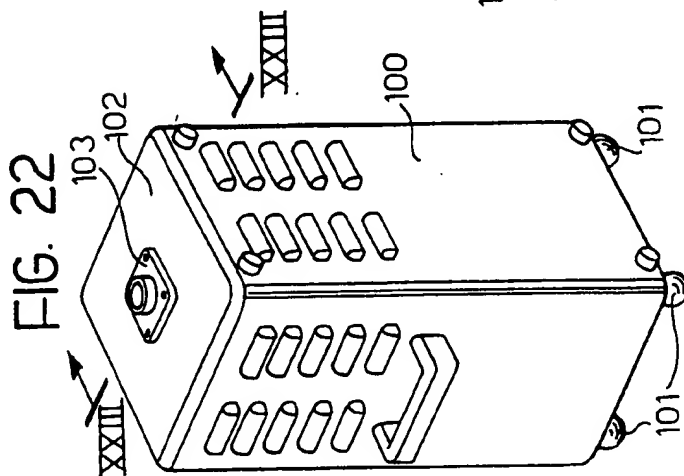
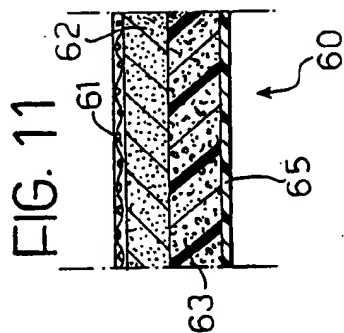
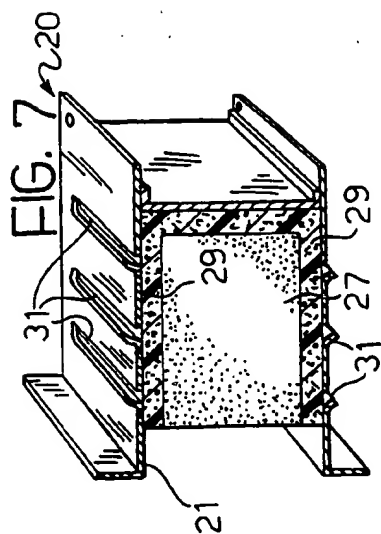
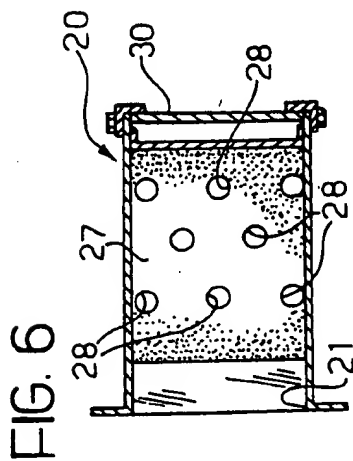


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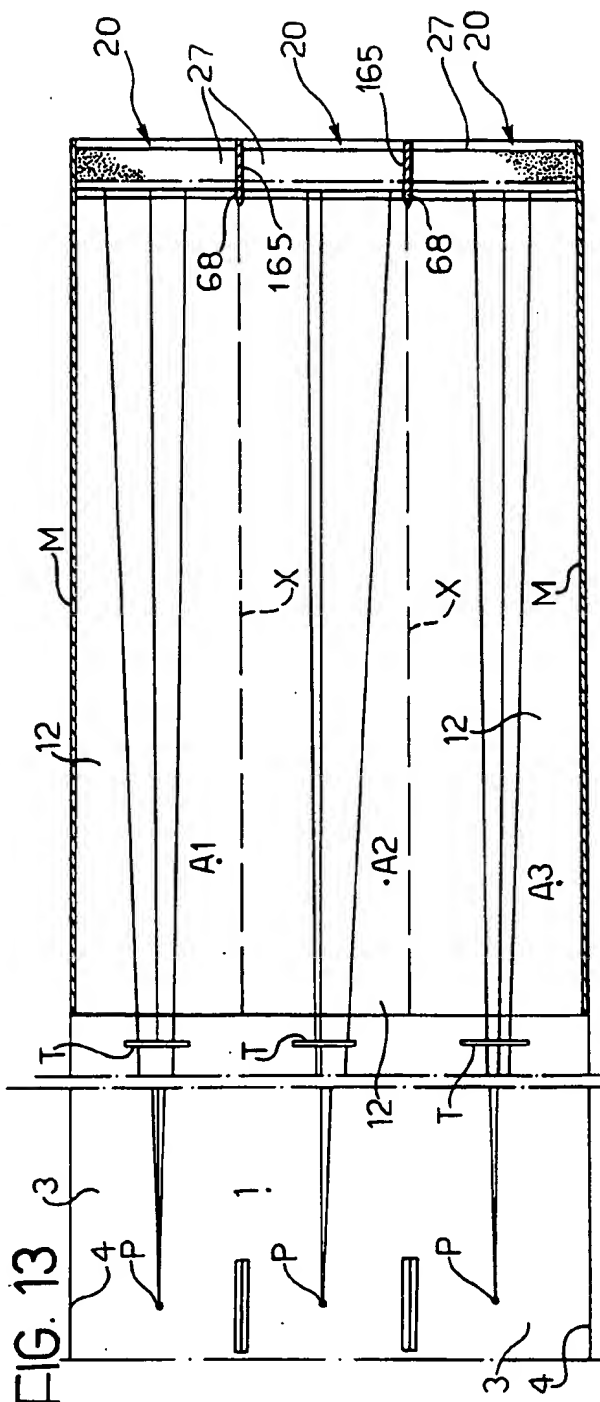
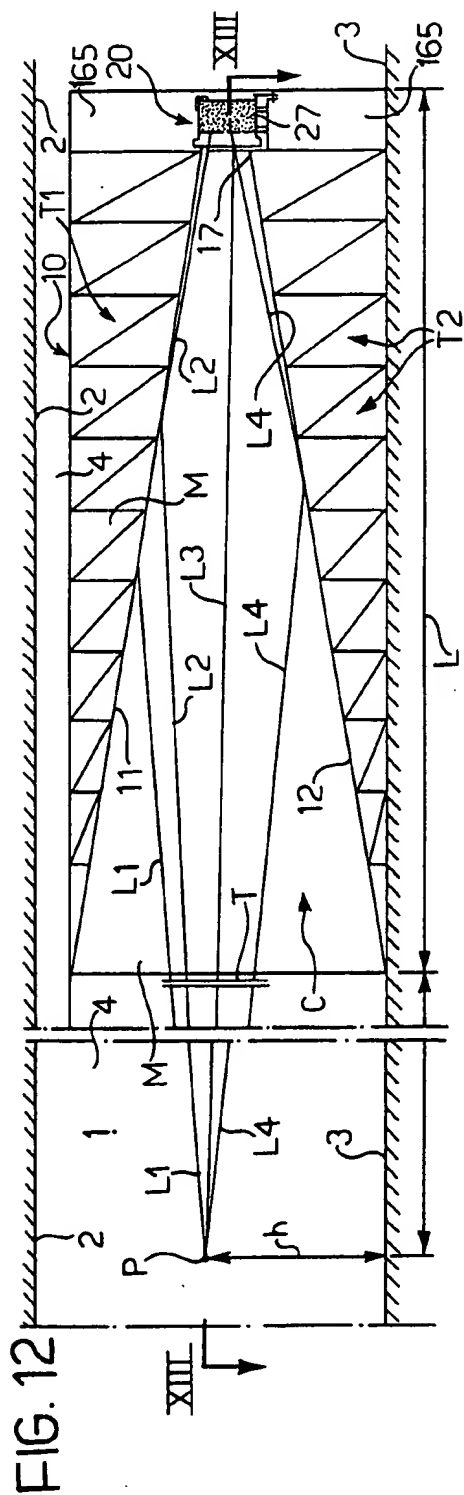
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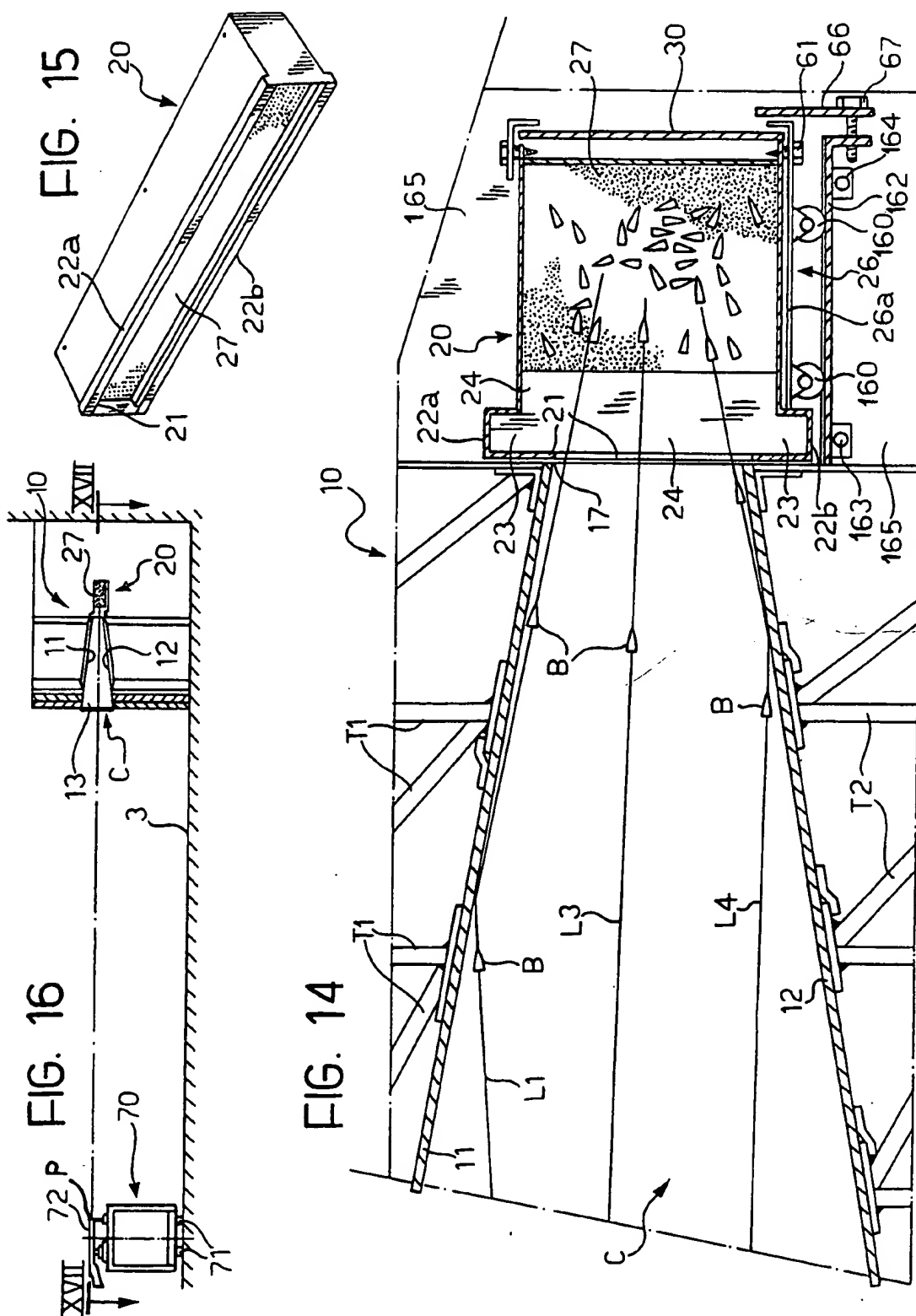
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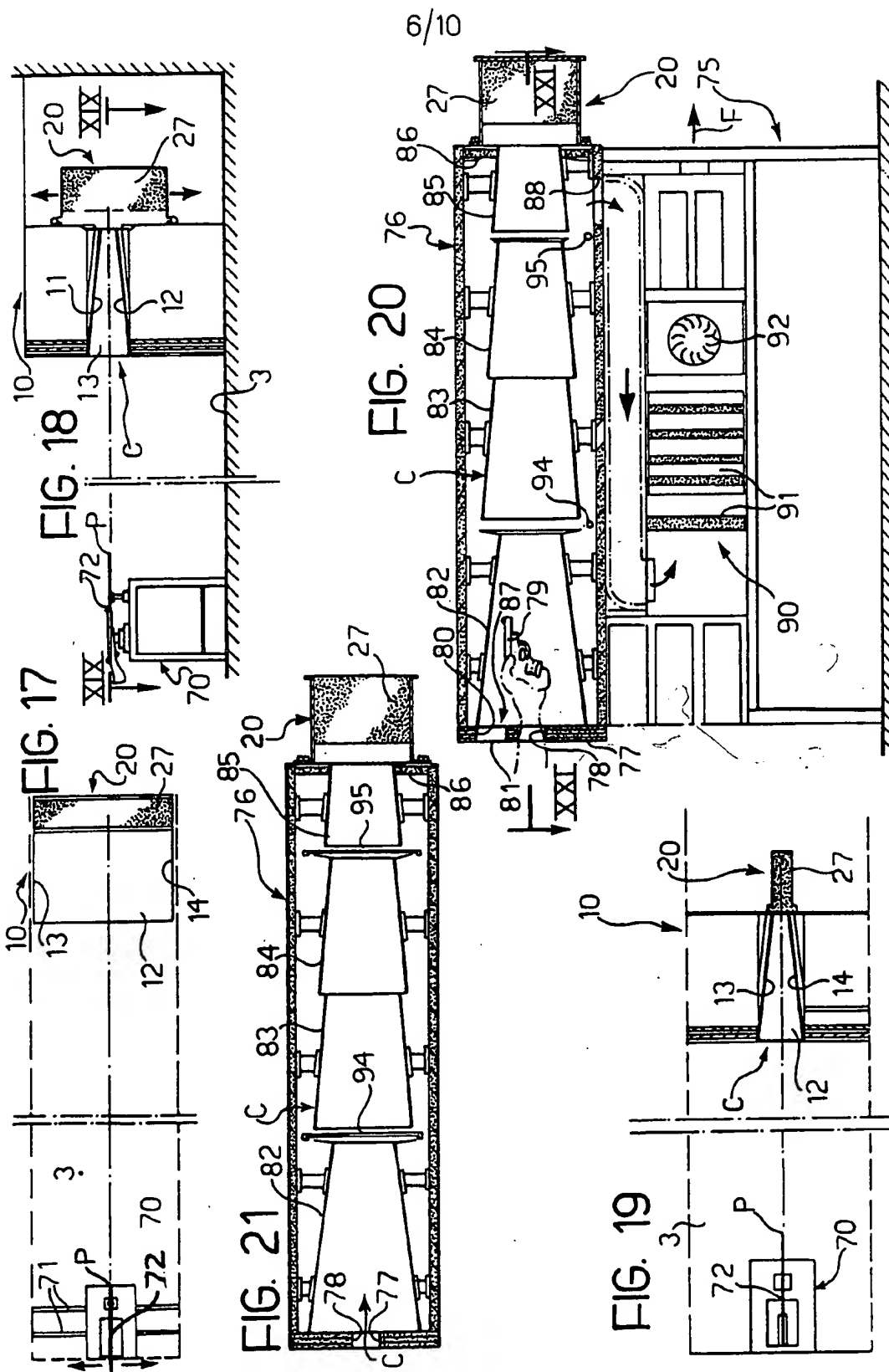


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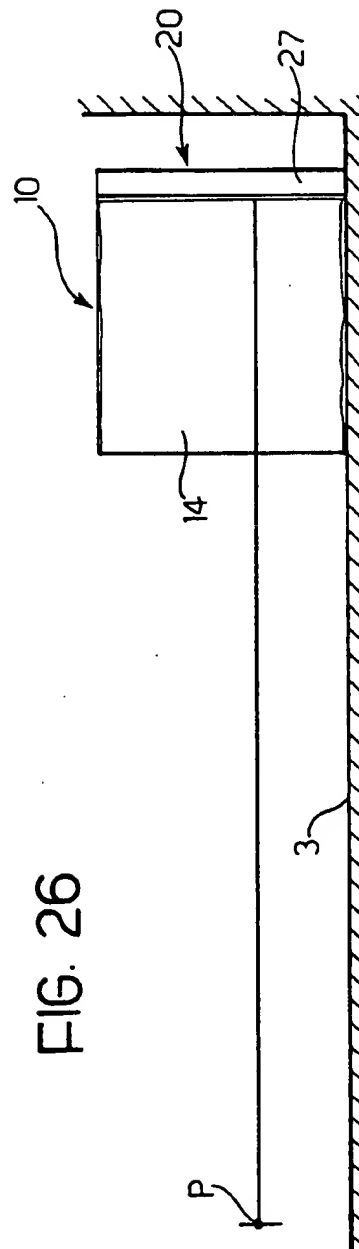
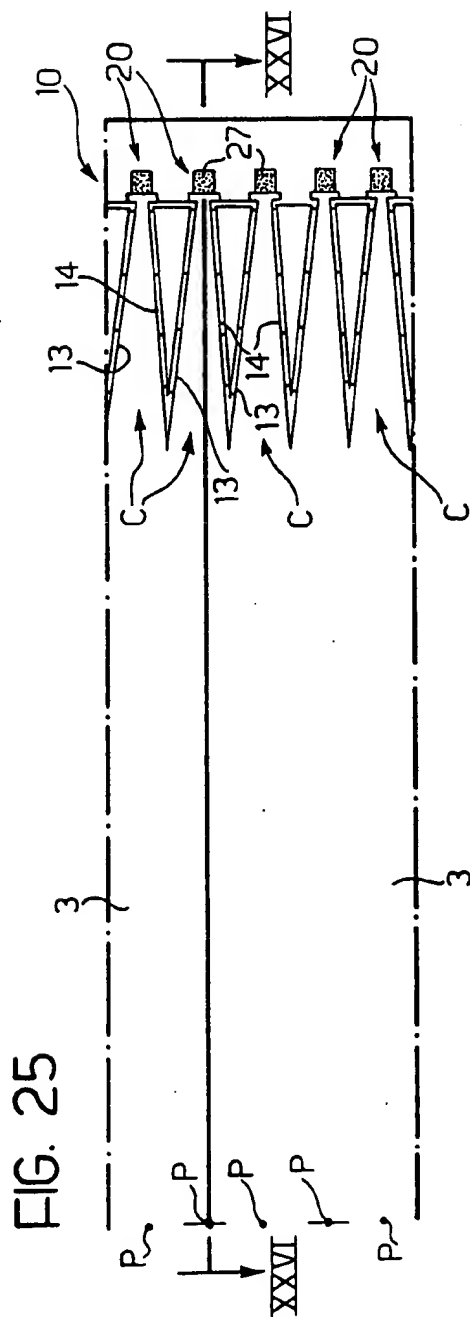
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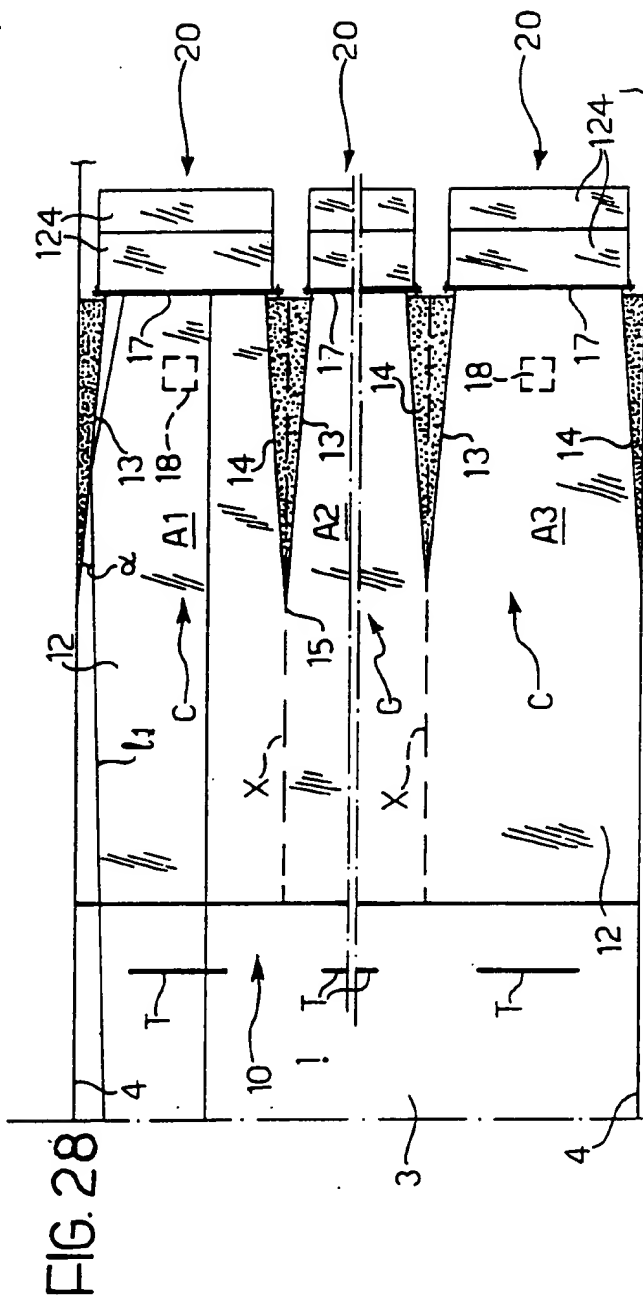
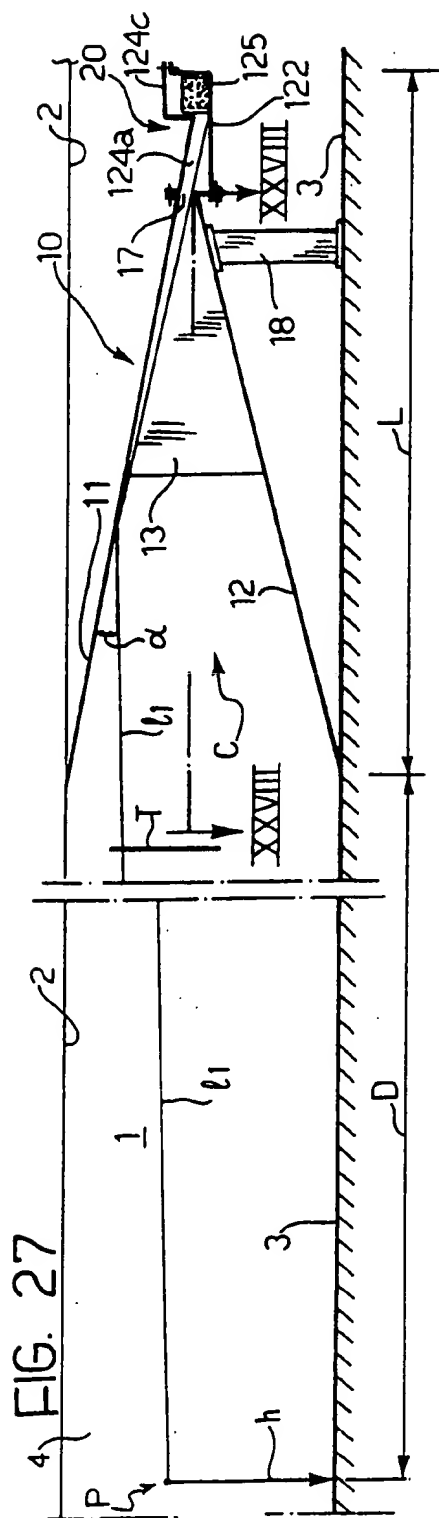
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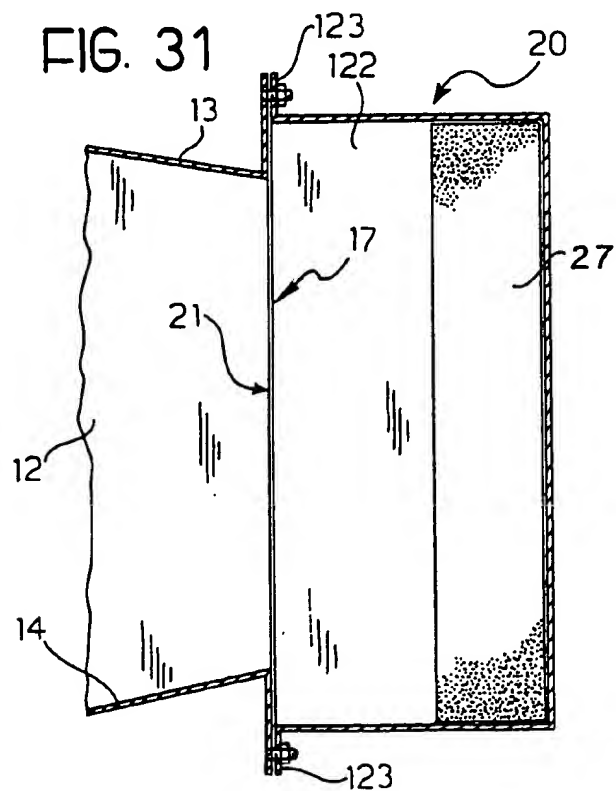
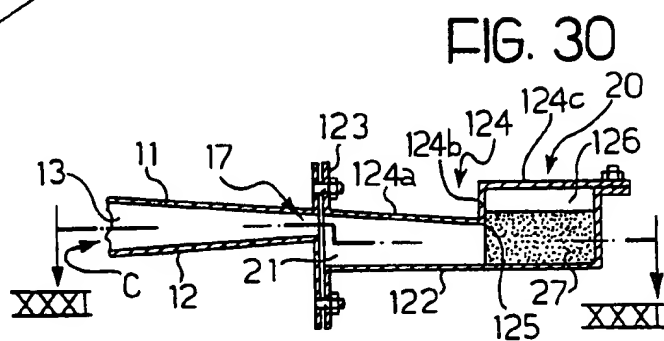
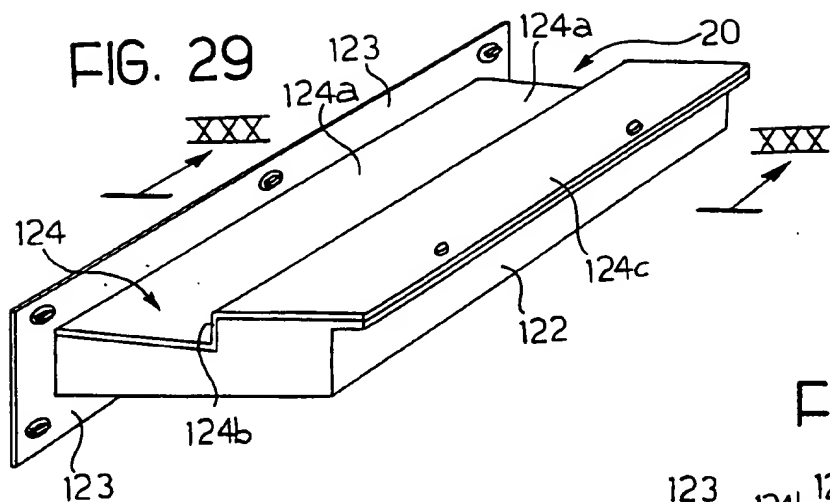


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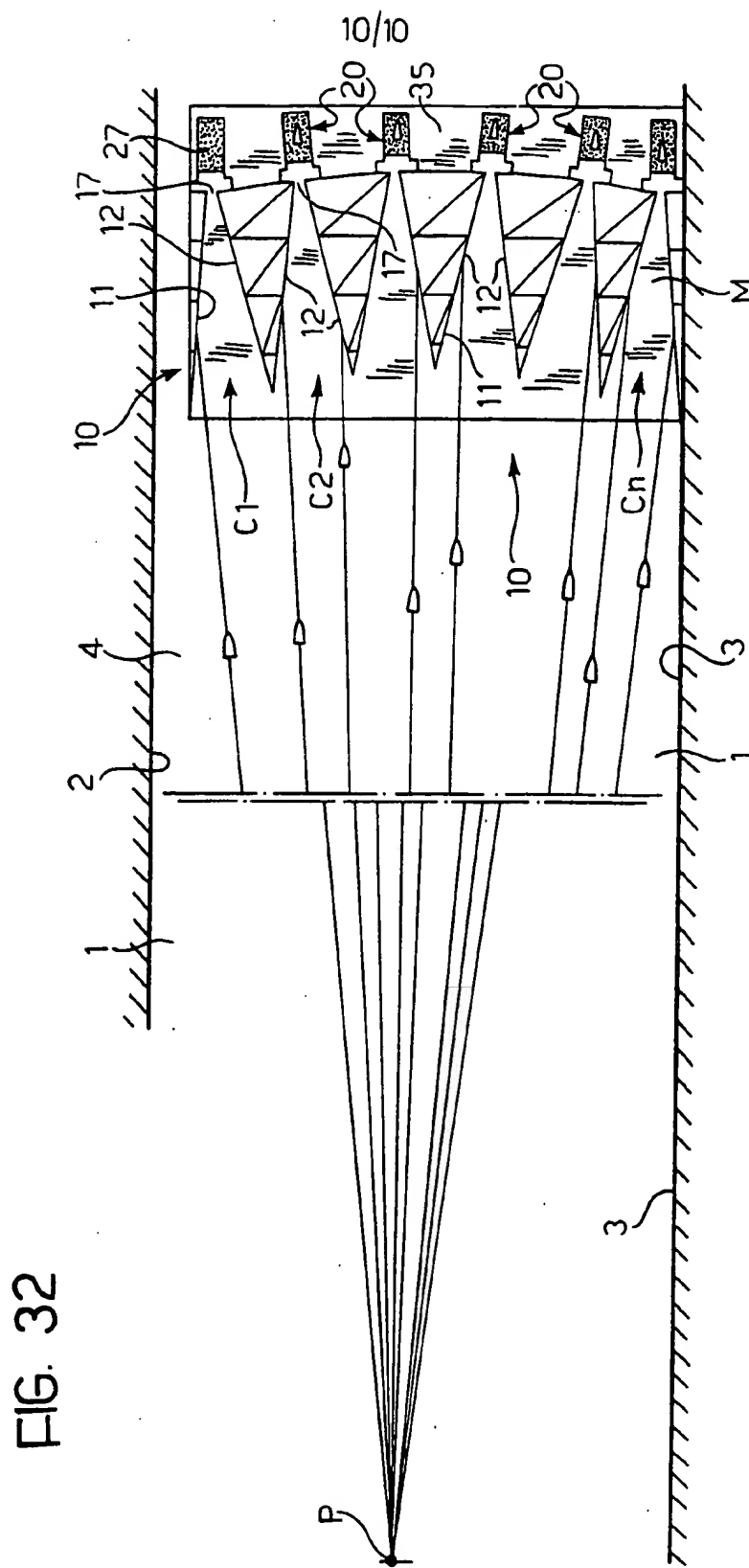


FIG. 32

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INTERNATIONAL SEARCH REPORT

International Application No

PCT/EP 94/01595

A. CLASSIFICATION OF SUBJECT MATTER
IPC 5 F41J1/12

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 5 F41J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	<p>WO,A,92 10717 (R. COBURN) 25 June 1992</p> <p>see page 2, line 32 - page 4, line 8; figure 1 see page 6, line 35 - page 8, line 7 see page 9, line 18 - page 10, line 29 see page 12, line 6 - page 13, line 22 see page 17, line 30 - page 18, line 17 see page 20, line 17-24 see page 21, line 26 - page 22, line 24 see page 26, line 33 - page 30, line 6</p> <p>--- -/--</p>	<p>1-7,9, 11,12, 15,16, 18, 20-22, 25-27, 30-35</p>

☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

8 September 1994

Date of mailing of the international search report

16.09.94

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Van der Plas, J

INTERNATIONAL SEARCH REPORT

International Application No

PCT/EP 94/01595

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP,A,0 518 330 (ROTTA GMBH) 16 December 1992 see column 2, line 24 - column 4, line 26 ---	1-7,9, 11,12, 15,16, 18, 20-22, 25-35
Y	DE,A,40 06 230 (BKE BILDECHNISCHES KONSTRUKTIONS-UND ENTWICKLUNGSBURO) 29 August 1991 see column 1, line 30-58; figures 1-4 see column 2, line 46-60 ---	5
Y	DE,A,34 42 984 (K. HENSELER) 28 May 1986 see page 5, line 21 - page 6, line 21; figure 2 ---	6
Y	US,A,4 856 791 (J. MCQUADE) 15 August 1989 see column 3, line 45 - column 4, line 57; figures 2-5 ---	7,9,11, 12
Y	EP,A,0 438 175 (A. WOJCINSKI) 24 July 1991 see column 6, line 16 - column 7, line 14; figures 6,7 ---	15,16,18
Y	WO,A,89 11076 (SIMONETTI) 16 November 1989 see page 6, line 20 - page 8, line 33; figures 1-15 ---	21,26-31
Y	US,A,4 509 301 (R. HEAD) 9 April 1985 see figures 1-10 ---	33,34
A	DE,A,32 12 781 (GFL-SPORTSTÄTTENBUA GMBH) 6 October 1983 see page 8, line 7 - page 9, line 24; figure 2 ---	6,22,32
A	US,A,4 787 289 (M.J. DUER) 29 November 1988 see the whole document ---	29
A	US,A,385 546 (O. DECUMBUS) 3 July 1888 see figure 3 ---	33
A	EP,A,0 369 401 (SIS VERWALTUNGSGESELLSCHAFT FÜR SCHIESSTRAININGSSYSTEME) 23 May 1990 see claims 1,2,12-15 ---	1,2
A	EP,A,0 238 004 (A. WOJCINSKI) 23 September 1987 ---	

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INTERNATIONAL SEARCH REPORT

Int: onal Application No
PCT/EP 94/01595

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE,B,28 47 742 (W. KLEIBÖMER) 3 January 1980 ---	
A	EP,A,0 122 862 (M. BARAVAGLIO) 24 October 1984 ---	
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